From:	PETERSON Jenn L
To:	Eric Blischke/R10/USEPA/US@EPA; Burt Shephard/R10/USEPA/US@EPA
Cc:	Bob Dexter; jay.field@noaa.gov; jeremy_buck@fws.gov; Joe Goulet/R10/USEPA/US@EPA; jpeers@stratusconsulting.com; Robert W. Gensemer; Robert.Neely@noaa.gov; sheila@ridolfi.com
Subject:	RE: Fw: Nutritional deficiency levels of zinc in aquatic life
Date:	08/22/2008 08:13 AM

I am out of the office, but I will respond briefly by questing whether or not we have confidence in the relationships between whole body concentrations in the organism and relating that as to whether they are at levels of "nutritional needs" and not at a level of potential adverse effects. I would say that there is a lot of uncertainty in just relating toxic responses to the body burden in the test. These toxicity tests in no way addressed the issue of nutritional levels and in fact may not have even addressed a strong causal relationship between exposure and mechanism of toxicity in the organism. I have never seen TRVs adjusted in this manner, but please correct me if I am wrong.

Perhaps a better way to deal with this is in the weight of evidence framework, where we can more effectively consider issues of causality instead of attempting to place more certainty in the analysis that actually exists by defining body burdens in terms of "nutritional and o.k." versus "adverse effect.

-Jennifer

-----Original Message-----
From: Blischke.Eric@epamail.epa.gov
[mailto:Blischke.Eric@epamail.epa.gov]
Sent: Thursday, August 21, 2008 10:29 AM
To: Shephard.Burt@epamail.epa.gov
Cc: Bob Dexter; jay.field@noaa.gov; jeremy_buck@fws.gov; Goulet.Joe@epamail.epa.gov; jpeers@stratusconsulting.com; PETERSON Jenn L; Robert W. Gensemer; Robert.Neely@noaa.gov; sheila@ridolfi.com
Subject: RE: Fw: Nutritional deficiency levels of zinc in aquatic life

Burt and others, the information presented below suggests that nutritional requirements are in the 18 - 36 range for fish and in the 40 - 50 range for invertebrates. I would like to point out that we have limited whole body tissue samples that exceed these concentration ranges.

The only fish that exceed 36 mg/kg zinc are carp. All whole body carp samples are in the 72 - 113 mg/kg range. The only fish that exceed 20 mg/kg are peamouth (23.1 - 24.7 mg/kg) and chinook (29.6 - 33.3 mg/kg).

For invertebrates, All invertebrates are less than 40 mg/kg with the exception of 8 clam samples in the 40 -54 mg/kg range and one mussel at 41.5 mg/kg.

Based on these sample results and the information regarding nutritional requirements below, I would have a hard time saying that the invertebrate tissue data exceed nutritional requirements. Thus, I recommend that we do not develop an invertebrate TRV for zinc.

For fish, only carp seems to exceed concentrations that are within the nutritional requirement range. However, the fact that we have TRVs that are well below the nutritional requirements (e.g., the 1979 Holcombe study), it seems that some adjustment needs to be made to ensure that a study such as Holcombe is not included - I do not think we can say with any confidence that the effects noted in the Holcombe study are not related to a nutritional deficiency. Further, I am not sure that Bob's proposal to adjust the ACR will solve the problem since it will not affect the Ozoh and Jacobson (1979) and Farmer (1979) studies. The Holcombe study will similarly be unaffected.

In general, I would be very uncomfortable taking an action to address zinc contamination based on tissue residue TRV that is not significantly different from the nutritional requirement.

Eric

Burt Shephard/R10/USEPA/US 08/21/2008 09:14 AM		To "Robert W. Gensemer" <rgensemer@parametrix.com> cc Bob Dexter <bob@ridolfi.com>, Eric Blischke/R10/USEPA/US@EPA, "jay.field@noaa.gov" <jay.field@noaa.gov>, "jeremy_buck@fws.gov" <jeremy_buck@fws.gov>, Joe Goulet/R10/USEPA/US@EPA, "jpeers@stratusconsulting.com" <jpeers@stratusconsulting.com>, Jennifer L Peterson <PETERSON.Jenn@deq.state.or.us>,

"Robert.Neely@noaa.gov"
<Robert.Neely@noaa.gov>,
"sheila@ridolfi.com"
<sheila@ridolfi.com>

Subject
RE: Fw: Nutritional deficiency levels of zinc in aquatic life (Document link: Eric Blischke)

Bob,

The Muyssen and Janssen 2002 paper on Daphnia magna is the best all in one paper I know of that describes residues associated with nutritional deficiency, sufficiency and toxicity in a single paper. Their zinc whole body wet weight ranges are as follows, assuming 80% water content to convert their dry weight measurements to wet weight.

17.4 - 29.6 mg/kg - deficiency, decreased reproduction and growth 42.4 - 50.8 - sufficiency, maximum reproduction and growth 92.6 mg/kg - toxicity, decreased reproduction and growth

The Spry et al. 1988 study on rainbow trout has deficiency and sufficiency whole body residues as follows (also converted from the orignial dry weight to wet weight assuming 80% water content)

7.7 mg/kg - deficiency, increased mortalilty, decreased growth 35.8 mg/kg - sufficiency, no mortality, normal growth

The Ogino and Yang 1978 study with rainbow trout also was designed as a nutritional deficiency study, not a toxicity study. They had better dose spacing than Spry et al. 1988, yielding wet weight results as given below. Ogino and Yang measured dry weight zinc residues, but also measured mositure content of the fish, so no assumptions on moisture content are necessary to obtain wet weight residues.

6.1 - 8.1 mg/kg - deficiency, increased mortality, decreased growth, decreased lipid content, increased fin erosion, increased cataract incidence 18.8 - 20.3 mg/kg - sufficiency, no effect on the above endpoints

Ogino and Yang's two highest zinc exposure doses were 15 and 30 mg/kg zinc in the diet, resulting in almost no difference in whole body residues (18.8 and 20.3 mg/kg whole body), demonstrating the ability of rainbow trout to homeostatically regulate their body burdens of zinc fed dietary concentrations between 15 and 30 mg/kg zinc. Their studies also went as long as 16 weeks, so they are certainly chronic studies.

Best regards,

Burt Shephard
Risk Evaluation Unit
Office of Environmental Assessment (OEA-095)
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"If your experiment needs statistics to analyze the results, then you ought to have done a better experiment"
- Ernest Rutherford

"Robert W. Gensemer" <rgensemer@parametrix.com>
08/20/2008 01:20 PM

To
Burt Shephard/R10/USEPA/US@EPA, Eric Blischke/R10/USEPA/US@EPA

cc
Bob Dexter <bob@ridolfi.com>, "jay.field@noaa.gov" <jay.field@noaa.gov>, "jeremy_buck@fws.gov" <jeremy_buck@fws.gov>, Joe Goulet/R10/USEPA/US@EPA, "jpeers@stratusconsulting.com" <jpeers@stratusconsulting.com>, Jennifer L Peterson <PETERSON.Jenn@deq.state.or.us>, "Robert.Neely@noaa.gov" <Robert.Neely@noaa.gov>, "sheila@ridolfi.com" <sheila@ridolfi.com>

Subject
RE: Fw: Tissue TRVs for Zinc and DDX

Burt: Thanks for the papers. My preference at this point would be to try adjusting all the ACRs we used to 2 since we have a chemical-specific value for this that we know is substantially lower than 8.3. This is also consistent with the development methods, and so is supportable in that sense. After we do this, then lets compare to the deficiency numbers again to see where we're at.

Also, does any of the deficiency literature also look at toxic concentrations to get a sense of whether these concentrations ranges (deficiency vs. toxicity) are pretty close together? If so, that might make us feel better about having a TRV that is not substantially higher than the deficiency levels (assuming the TRV goes up enough after changing the ACR of course). -Bob

-----Original Message-----
From: Shephard.Burt@epamail.epa.gov
[mailto:Shephard.Burt@epamail.epa.gov]
Sent: Wednesday, August 20, 2008 1:10 PM
To: Blischke.Eric@epamail.epa.gov
Cc: Bob Dexter; jay.field@noaa.gov; jeremy_buck@fws.gov; Goulet.Joe@epamail.epa.gov; jpeers@stratusconsulting.com; Jennifer L Peterson; Robert W. Gensemer; Robert.Neely@noaa.gov; sheila@ridolfi.com
Subject: Re: Fw: Tissue TRVs for Zinc and DDX

Hello all,

This is to let everyone know that the zinc tissue TRVs of 6.4 and 11.3 mg/kg wet weight for fish, and 5.0 mg/kg for invertebrates will have to be reworked, as the proposed values in the August 4th draft are at the documented nutritional deficiency range for a number of aquatic species, including rainbow trout (Ogino and Yang 1978, Spry et al. 1988), Atlantic salmon (Maage and Julshamn 1993), Daphnia magna (Muyssen and Janssen 2002), and numerous marine molluscs and crustaceans (White and Rainbow 1985). The zinc TRVs are also nutritionally deficient when expressed as dietary concentrations in prey consumed by higher trophic level aquatic species (Clearwater et al. 2002, Watanabe et al. 1997). Several of these papers are attached, references are given to the rest. Most of the dietary sufficiency concentrations are expressed as dry weights , so be careful when reviewing Clearwater and Watanabe in particular. Whole body zinc as high as 29.6 mg/kg is nutritionally deficient in Daphnia magna, while roughly 8 mg/kg whole body is a deficiency level in rainbow trout. Dietary concentrations of zinc of 15-30 mg/kg are required for adequate growth in rainbow trout.

Zinc is known to be an essential micronutrient for animals. It is a specific cofactor of 20+ enzymes, including alkaline phosphatase and carbonic anhydrase. Zinc deficiency in fish results in growth reduction, increased mortality, cataract formation imparing vision, and alters the function of antioxidant enzymes. One estimate of average zinc concentrations in fish throughout the U.S. is a geometric mean of 21.7 mg/kg (Schmitt and Brumbaugh 1990), a factor of 2-4x higher than the TRVs.

The low values for the zinc TRVs are likely due to dividing the lethal body burdens by the default acute-chronic ratio of 8.3 instead of measured ACRs for zinc, which are in the neighborhood of 2. Mortality has been identified as the most sensitive endpoint for some aquatic species such as rainbow trout (De Schamphelaere and Janssen 2004), so maybe the solution is not to use the ACR adjustment for mortality for zinc studies. Just a suggestion, we need some additional discussion and ideas regarding how to fix the zinc TRV. Any thoughts are welcome.

Best regards,

Burt Shephard
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"If your experiment needs statistics to analyze the results, then you ought to have done a better experiment"
- Ernest Rutherford

(See attached file: Ogino and Yang 1978.pdf)(See attached file: Muyssen and Janssen 2002.pdf)(See attached file: Watanabe et al 1997.pdf)(See attached file: Clearwater et al 2002.pdf)(See attached file: DeSchamphelaere and Janssen 2004.pdf)

Maage, A. and K. Julshamn. 1993. Assessment of zinc status in juvenile Atlantic salmon (Salmo salar) by measurement of whole body and tissue levels of zinc. Aquaculture 117:179-191.

Schmitt, C.J. and W.G. Brumbaugh. 1990. National comtaminant biomonitoring program: Concentrations of arsenic, cadmium, copper, lead, mercury, selenium and zinc in U.S. freshwater fish. Archives of Environmental Contamation and Toxicology 19:731-747..

Spry, D.J., P.V. Hodson and C.M. Wood. 1988. Relative contributions of

dietary and waterborne zinc in the rainbow trout, Salmo gairdneri. Canadian Journal fo Fisheries and Aquatic Sciences 45:32-41.

White, S.L and P.S. Rainbow. 1985. On the metabolic requirements for copper and zinc in mollusks and crustaceans. Marine Environmental Research 16:215-229.

Eric Blischke/R10/USEPA/US
08/04/2008 12:34 PM

To: jeremy_buck@fws.gov, Joe Goulet/R10/USEPA/US@EPA, Jennifer L Peterson <PETERSON.Jenn@deq.state.or.us>, Burt Shephard/R10/USEPA/US@EPA, Robert.Neely@noaa.gov, rgensemer@parametrix.com, sheila@ridolfi.com, jay.field@noaa.gov, jpeers@stratusconsulting.com, Bob Dexter <bob@ridolfi.com>
cc:
Subject: Fw: Tissue TRVs for Zinc and DDX

Below are the TRVs for Zinc and DDX. Comments are due to EPA by COB, August 12, 2008.

Thanks, Eric
----- Forwarded by Eric Blischke/R10/USEPA/US on 08/04/2008 12:34 PM -----

"Robert W. Gensemer" <rgensemer@parametrix.com>
08/04/2008 12:01 PM

To: Eric Blischke/R10/USEPA/US@EPA, Burt Shephard/R10/USEPA/US@EPA
cc: David DeForest <deforest@parametrix.com>, "Carrie A. Smith" <CSmith@parametrix.com>
Subject: Tissue TRVs for Zinc and DDX

Eric: Attached are the draft TRVs for zinc and DDX for internal government team review. Sorry these took so long, but they were data rich and challenging, particularly DDX.

Let me know if you have any questions,
-Bob

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[attachment "Zinc Draft Tissue TRV Data (4 Aug 2008).xls" deleted by Burt Shephard/R10/USEPA/US] [attachment "DDX Draft Tissue TRV Data (4 Aug 2008).xls" deleted by Burt Shephard/R10/USEPA/US] [attachment "DDX Draft Tissue TRV (4 Aug 2008).doc" deleted by Burt Shephard/R10/USEPA/US] [attachment "Zinc Draft Tissue TRV (4 Aug 2008).doc" deleted by Burt Shephard/R10/USEPA/US]